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SUPERSEDING
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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION

OMNIDIRECTIONAL APPROACH LIGHTING SYSTEM (ODALS)

1. SCOPE

1.1 Scope.- This specification covers the requirements of the Federal Aviation Administration for an Omnidirectional Approach Lighting System (ODALS). The system consists of seven sequenced omnidirectional capacitor discharge strobe light units and associated equipment to be installed at the approach end of non-precision runways. The system shall include provisions for installation by others of radio remote control equipment.

2. APPLICABLE DOCUMENTS

2.1 FAA documents.- The FAA specifications, standard and drawings, of the issues specified in the invitation for bids or request for proposals, form a part of this specification, and are applicable to the extent specified herein.

2.1.1 FAA specifications.

FAA-E-1100	Photometric Test Procedures for Flashing Lamps
FAA-E-2604	Low Impact Resistance Structures for Medium Intensity Approach Lighting Systems

FAA-G-2100/1	Electronic Equipment, General Requirements, Part 1, Basic Requirements for all Equipment
FAA-G-2100/3	Part 3, Requirements for Equipments Employing Semiconductor Devices
FAA-D-2494/1	Instruction Book Manuscripts Technical; Equipment and Systems Requirements, Part 1
FAA-D-2494/2	Instruction Book Manuscripts Technical; Equipment and Systems Requirements, Part 2
FAA-C-2642	Construction of an Omnidirectional Approach Lighting System

2.1.2 FAA standard

FAA-STD-013	Quality Control Program Requirements

2.1.3 FAA drawings

B-4904	Frangible Coupling, Type 1 and 1A, Details
B-21216	Standard Nameplate
D-6067	Omnidirectional Approach Lighting System

2.2 Military and Federal Publications.- The following Military and Federal publications, of the issues in effect on date of the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein.

2.2.1 Military Specifications

MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-E-17555	Electronic and Electrical Equipment, and Associated Repair Parts, Preparation for Delivery of
MIL-HDBK-472	Maintainability Prediction
MIL-T-704	Treatment and Painting of Material
MIL-T-27	Transformers and Inductors, General Specification for
MIL-P-15024	Plates, Tags, and Bands for Identification of Equipment
MIL-C-7989	Covers, Light Transmitting Aeronautical Lights
MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment
MIL-C-005015	Connectors, Electric, AN Type

2.2.2 Military Standards

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-470	Maintainability Program Requirements
MIL-STD-471	Maintainability Verification/Demonstration/Evaluation
MIL-STD-781	Reliability Tests Exponential Distribution
MIL-STD-785	Requirements for Reliability Program
MIL-STD-810	Environmental Test Methods

2.2.3 Federal Specifications

TT-E-485	Enamel, Semigloss, Rust-Inhibiting
TT-E-489	Enamel, Alkyd, Gloss (for exterior and interior surfaces)
TT-P-641	Primer, Coating, Zinc Dust-Zinc Oxide
TT-P-645	Primer, Paint, Zinc-Chromate, Alkyd Type
TT-P-1757	Primer Coating, Zinc-Chromate, Low-Moisture-Sensitivity

2.2.4 Federal Standard

595	Colors

2.3 Other Publications.- The following publication, of the issue in effect on the date of the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein.

2.3.1 American National Standards Institute (ANSI) Publication

C37.90a-1974	IEEE Guide for Surge Withstand Capability (SWC) Tests
C89.1-1961	American Standard Requirements and Terminology for Speciality Transformers (NEMA Pub. No. ST 1-1961)

2.3.2 National Fire Protection Association Publication

NFPA No. 70 National Electrical Code

2.3.3 Occupational Safety and Health Administration (OSHA) Regulations

National Standards Established by Occupational Safety and Health Administration

(Copies of this specification and other applicable FAA documents may be obtained from the Contracting Officer in the office issuing the invitation for bids or request for proposals. The requests should fully identify the material cited, i.e., standard, drawing, specification and amendment numbers and dates. Request should cite the invitation for bids, request for proposal, or contract involved or other use to be made of the requested material.)

(Request for copies of Military specifications should be addressed to Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.)

(Information on obtaining copies of Federal specifications and standards may be obtained from General Services Administration office in Washington, D.C.; Atlanta; Auburn, Washington; Boston; Chicago; Denver; Kansas City, Mo.; New York; San Francisco and Seattle.)

(Information on obtaining ANSI standards will be provided by the American National Standards Institute, 70 East 45th Street, New York, N.Y., and on obtaining the National Electrical Code will be provided by the National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts, 02110.)

(Information on obtaining copies of OSHA regulations may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

3. REQUIREMENTS

3.1 Equipment to be Furnished by the Contractor.- The equipment to be furnished under this specification for each system shall consist of items listed below.

(a) System power and control unit (3.8)

(b) Seven each omnidirectional strobe light units each consisting of a power supply unit and an Optical Head (3.9)

(c) Instruction Book Manuscript (Camera Ready Copy) (3.10)

3.2 General Functional Requirements.- The Omnidirectional Approach Lighting System (ODALS) provides visual guidance for circling, offset, and straight-in approach to non-precision runways. The system consists of seven omni-directional (360°) sequenced capacitor discharge strobe lights located in the approach area of the runway (see Figure 1). Five runway alignment strobe lights are installed along the extended runway centerline, beginning 300 feet from the threshold and spaced 300 feet (92 meters) apart. One runway end identifier strobe light is located 40 feet (13 meters) from each of the left and right runway edges adjacent to the runway threshold. Although ideal system installations will contain all seven lights in a single horizontal plane, sloping installations are permitted with a maximum positive slope of 2% and a maximum negative slope of 1%. Only one change in slope is permitted. Reference Figure 1 for system plan tolerances and Figure 2 for allowable system profiles.

The strobe light units are powered and controlled by the system power and control unit. Each strobe lights shall be capable of operating at either of three intensity settings, High, Medium, or Low. Intensity setting is accomplished by switching capacitors or other electrical methods within the strobe light unit induced by signal voltages from the system power and control unit. The ODALS shall be remotely controlled via a radio receiver/decoder (of the type specified in the contract) furnished and installed by others.

3.2.1 Construction Designs.- The Omnidirectional Approach Lighting equipment provided under this specification shall be capable of installation in accordance with Specification FAA-C-2642, "Construction of an Omni-directional Approach Lighting System" and FAA Drawings series D6067, "Omni-directional Approach Lighting System."

3.3 Materials and Parts.- Materials and parts shall be as specified herein. Where materials are not specifically designated, they shall be in accordance with FAA-G-2100/1b, paragraphs 1-3.15 and 1-3.16. All components and parts shall be suitable for operation under the environmental conditions as specified. Metal parts shall be either inherently corrosion-resistant or shall be suitably protected to resist corrosion or oxidation during extended service life. The use of dissimilar metals in contact with one another shall be avoided wherever practicable. However, if their use cannot be avoided, they shall be used in accordance with Military Standard No. 454, Requirement No. 16, Class 2.

3.3.1 Standardization.- All equipment and components furnished under this specification shall be interchangeable per MIL-STD-454, Requirement No. 7 without alterations in circuitry for power or control. The components of the entire assembly shall be directly interchangeable with any other like unit of equipment furnished under this specification.

3.3.2 Parts Rating.- All parts shall be of adequate rating for the application and shall not be operated in excess of the parts manufacturer's recommended ratings during operation of the equipment throughout the specified environmental range (3.6). Components shall be derated by the interior temperature rise above the maximum outside ambient temperature at an altitude of 6600 feet (2000 meters) MSL.

3.4 Workmanship and Processes.- Workmanship and processes shall conform to FAA-G-210/1, paragraphs 1-3.4 through 1-3.4.13 when methods or processes referenced by the above are utilized by the contractor or his suppliers in the production of the ODALS equipment.

3.5 System/Equipment Design.- Equipment design shall comply with National Electrical Code and OSHA. Design and maintenance criteria shall be established for an ODALS system that typically operates 10 hours a day, 365 days a year with intensity step changes made 10 times per hour.

3.5.1 Maintainability Design Criteria

3.5.1.1 System Maintenance Parameters.- The following maintenance parameters shall be met by the system:

(a) Mean Time to Restore (MTTR) -The ODALS system shall have an MTTR of not more than 15 minutes with no single restoration exceeding 3 hours in duration.

(b) Mean Periodic Maintenance Time (MPMT) -The ODALS system shall have an MPMT not exceeding 2 hours per month including routine inspection.

The above values are established under the assumption that spare parts for failed components are available at the site.

3.5.1.2 Maintainability Value Prediction.- The contractor shall predict maintainability values for each equipment making up the system. MIL-HDBK-472 contains techniques which may be used, or the contractor may submit a technique to the Contracting Officer for approval.

3.5.1.3 Equipment Design Guidelines.- The equipment design shall follow the maintainability design guidelines contained in MIL-STD-470, paragraph 5.4.

3.5.1.4 Maintainability Program.- The contractor shall establish a maintainability program per FAA-G-2100/1b, Amendment 2, paragraph 1-3.20 as modified herein. A proposed maintainability program plan for accomplishing requirements of 3.5.1.1 through 3.5.1.3, 4.2.1 and 4.4.4 shall be prepared and submitted to the Contracting Officer per 4.2.

3.5.2 Reliability Design Criteria

3.5.2.1 System Reliability Parameters.- The ODALS systems shall be designed and manufactured in accordance with the following reliability criteria.

(a) Mean Time Between Failure (MTBF) -MTBF for the system shall be not less than 2,500 hours (operational). A system failure occurs when power output tolerances from the system power and control cabinet are exceeded, when intensity step control is lost, when timer signals exceed their voltage or timing tolerances, or when two or more ODALS light units cease to operate within their tolerances.

(b) Total Number of Hardware Failure -The system total number of hardware failures shall not exceed five per every 2500 hours of operation. A hardware failure includes any component or part failure in the system, whether or not that part failure results in a system failure defined in 3.5.2.1(a).

3.5.2.2 Reliability Value Prediction.- Reliability predictions shall be made in accordance with MIL-STD-785A, paragraph 5.2.2.3.

3.5.2.3 Failure Mode and Effect Analysis (FMEA).- The FMEA as specified in MIL-STD-785A, paragraph 5.2.4 shall be performed on the ODALS system and each equipment.

3.5.2.4 Reliability Program.- The contractor shall establish a reliability program per FAA-G-2100/1b, Amendment 2, paragraph 1-3.19 as modified herein. A proposed reliability program plan for accomplishing requirements of 3.5.2.1 through 3.5.2.3, 4.2.1 and 4.4.5 shall be prepared and submitted to the Contracting Officer per 4.2.

3.5.3 Transient Suppression.- The equipment shall be designed to withstand repeated transient increases in the 240 VAC (RMS) line voltage superimposed at the system power and control cabinet power input for as long as 50 milliseconds on the AC line voltage waveform and reaching a peak voltage which is 120% of the peak value of AC line voltage. In addition, the equipment shall be designed to withstand repeated line transients applied at the control cabinet power input which are characterized as a 10 X 20 microsecond current surge of 15,000 amperes with the subsequent power-follow current and voltage surge of 10KV/microsecond minimum. The equipment shall restart automatically if an interruption or shutdown is experienced due to either type of transient. Equipment operational functions shall be unimpaired by the above transients when each type of transient is imposed a minimum of ten (10) times each to the system power and control cabinet power input terminal block.

3.6 Environmental Conditions.- The equipment shall be designed for continuous operation outdoors under the following environmental conditions.

3.6.1 Temperature.- An ambient temperature range from 55°C to +55°C.

3.6.2 Altitude.- Sea level to 6,600 feet MSL.

3.6.3 Humidity.- Up to 95 percent from sea level to 6,600 feet and 55°C (+131°F) ambient temperature.

3.6.4 Sand and Dust.- Exposure to wind blown sand and dust particles as may be encountered in arid regions.

3.6.5 Salt Spray.- Exposure to salt laden atmosphere.

3.6.6 Rain, Snow and Ice.- Exposure to wind blown rain, snow, hail, and sleet.

3.6.7 Jet-Blast Propelled Gravel.- The unit shall be capable of with-ounce gravel particle traveling at a velocity of one hundred (100) miles per hour.

3.7 System Control and Operation Requirements.- Refer to Figure 1 for the ODALS system layout. The ODALS light units #1 through #5 flash in sequence toward the runway threshold at the rate of once per second, with each cycle followed by a simultaneous flash of units #6A and #6B. The interval between flashes of units #1 through #5 shall be 1/15 second plus or minus 10 percent. The interval between the flash of unit #5 and the simultaneous flash of units #6A and #6B shall be 4/15 second plus or minus 10 percent. The period between the flash of units #6A and #6B and the start of a new cycle shall be 7/15 second plus or minus 10 percent. The ODALS system shall be capable of operating at either of three intensity settings, High, Medium, and Low. The system shall have provisions local and remote radio control as specified herein. All intensity changes shall be completed within 1.5 seconds of initiating intensity change. The power output to the ODALS flashers may be interrupted up to a maximum of 1.5 second, if required, during intensity step change operations. Circuitry shall prevent intensity step changing during the discharge of a flash capacitor.

3.7.1 Local Control.- A local control switch shall be installed in the power and control unit cabinet to permit local control of the system. The switch shall have five positions, labeled as follows, to perform the indicated functions.

Switch Position	Function
OFF	Power and Control circuits to the ODALS lights deenergized.
AUTO	System controlled (on-off and intensity) by remote control.

Switch Position	Function
LOW	System operating at low intensity.
MEDIUM	System operating at medium intensity.
HIGH	System operating at high intensity.

3.7.2 Remote Control.- The system power and control unit shall have space and provisions for installation by others of a 120 Volt AC remote control radio receiver/decoder unit and ancillary equipment of the type specified in the contract. The remote control circuitry shall consist of the following five interface terminals:

1. On/Off/High Intensity
2. Medium Intensity
3. Low Intensity
4. 120V AC
5. AC Common Power

3.7.2.1 AC Common Power.- The 120 VAC/AC common power circuit shall be fused and have sufficient capacity for control functions and furnishing of power to operate a receiver/decoder. This circuit shall be energized for all positions of the local control switch in the system power and control unit.

3.7.2.2 On/Off/High Intensity.- With the local control switch in the automatic position, this control function, with the application of 120V AC through a switch or relay, shall turn on the system at High Intensity. With the absence/removal of 120V AC at this terminal the system is off/ turns off, except that when an air-to-ground radio system is used, a timer will automatically turn the system off 15 minutes after activation or the last intensity step change.

3.7.2.3 Medium Intensity.- With the local control switch in the automatic position and with the system operating at High Intensity, this control function with the application of 120V AC through a switch or relay shall lower the system intensity to the Medium Intensity setting. (The absence or removal of 120V AC at this terminal shall cause the system to operate at/revert to the High Intensity setting provided that a 120V AC signal is applied at the On/Off/High Intensity terminal.)

3.7.2.4 Low Intensity.- With the local control switch in the automatic position and with the system operating at Medium Intensity, this control function with the application of 120V AC through a switch or relay shall lower the system intensity to the Low Intensity setting. (The absence or removal of 120V AC at this terminal shall cause the system to operate at/revert to the Medium Intensity setting provided that a 120V AC signal is applied at the On/Off/High Intensity terminal and at the Medium Intensity terminal.)

3.7.2.5 Remote Control Equipment.- The remote control equipment is not required under this specification. The System Power and Control Unit (3.8) shall include space and provisions for installation by others of a radio receiver/decoder and ancillary equipment as specified in the contract. The contractor shall provide all necessary equipment to conduct all Operational Tests (4.5.13 and 4.5.7).

3.8 System Power and Control Unit.- The system power and control unit contains the mechanical and electrical components, circuitry, and controls for power and control of the ODALS System. The cabinet housing shall be per paragraph 3.8.12 and shall be fitted with a hinged door and accessories per paragraph 3.8.13. All mechanical and electrical components shall be mounted on a removable mounting panel per paragraph 3.8.16. No mounting bolts, either for the mounting panel or components, shall protrude through the cabinet exterior surfaces. No electrical components shall be mounted on the cabinet door. A ground lug shall be installed on the interior of the cabinent per paragraph 3.8.10. A wiring diagram plate per paragraph 3.8.15 shall be provided. Relays shall be per paragraph 3.11.1 and contactors shall be per paragraph 3.8.5. Space shall be reserved for field installation of conduits for all external cable connections. Access shall be provided for maintenance and replacement of all equipment components, without removal of other components. The removable equipment mounting panel shall include space and provisions for installation by others of the remote control receiver/decoder unit and ancillary equipment of the type specified in the contract. The system power and control unit shall be capable of installation on a maximum of four (4) 2-inch frangible couplings per FAA-B-4904 with 12-inch high nipples so as to withstand a one hundred (100) mile per hour wind load applied from any direction. The system power and control unit shall have a maximum weight (not including the radio receiver/decoder unit) of one hundred fifty pounds. All equipment shall be designed as required to meet the reliability and maintainability criteria (3.5).

3.8.1 Power Supply.- Power supply for operation of the ODALS shall be from a 120/240 $\pm$ 10% volt, 60 Hertz, 3-wire, grounded source.

3.8.2 Circuitry.- Power supply to the system power and control unit shall be as specified in paragraph 3.8.1. The unit shall provide 120/240 VAC power and 120 VAC on/off, intensity control, and timing pulses to the ODALS strobe lights. Power for operation of the radio receiver/decoder unit and interface circuits for remote controls shall be as specified in paragraph 3.7.2.

3.8.3 Local Control Switch.- A manual control selector switch shall be installed in the upper right quadrant of the control cabinet. The switch shall be a labeled five-position switch providing control functions specified in paragraph 3.7.1. Starting with the AUTO position as the selector knob is rotated clockwise it shall proceed to the OFF, LOW, MEDIUM, and HIGH positions.

Play and backlash in the switch shall be held to a minimum commensurate with intended operational functions and shall not cause poor contact nor inaccurate settings. Each functional position shall be identified by a mechanical stop as well as by position.

3.8.4 Entrance Switch.- A 2-pole 30 AMP, 240 VAC, heavy duty, dead front safety switch box equipped with 30 AMP, 2-pole, thermal-magnetic circuit breaker shall be provided as the primary disconnecting device in the 240 VAC input service. The operating mechanism shall be quick-make and quick-break. The switch shall break the AC power line immediately after the line enters the control cabinet via terminal block or connector, and before the line reaches other fuses or parts except as noted in 3.8.8. The switch shall be mounted in the upper right quadrant of the control cabinet at a location which will provide easy and safe access to the operating handle.

3.8.5 Contactors.- Lighting type contactors of adequate rating and suitable for the intended application shall be provided for on-off switching of power to the ODALS lights. The contactors shall be controlled by the local control switch (3.7.1) when operated locally, or by the radio control system (3.7.2) when operated remotely, and shall be installed in such a manner that their operation does not adversely affect other components. The contactors shall be rated for a minimum of 20,000 operations.

3.8.6 Master Timer.- An electro-mechanical timer shall be installed in the system power and control cabinet to provide triggering pulses for the ODALS flashers. The timer shall provide a pulse of 120 VAC ± 5% to each flasher unit with a control cabinet power input of 120/240 VAC. The timer output rating shall be not less than 10 amperes. There shall be six contacts provided to operate the flashers as specified in paragraph 3.7. The motor shall be of the self-lubricating, self starting synchronous type capable of operating the cam load continuously without exceeding the temperature rise limits of the motor and shall not create a termperature rise in the closed invironment of the cabinet that could damage or adversely affect other components. A dust cover shall be provided to protect the contacts. Lubricants shall be in accordance with FAA-G-2100/1b, paragraph 1-3.15.4.2.

3.8.7 Elapsed Time Meter.- An elapsed time meter shall be installed in the system power and control cabinet to indicate the number of hours of operation on the high intensity step position. The meter shall indicate up to 999 hours and indicate total time in hours and tenths of hours. The meter shall be a recycling type and shall be General Electric Type 909X85 or equal.

3.8.8 Maintenance Light and Convenience Outlet.- A 100 watt, 120 VAC, light with a protective wire mesh cover that is grounded shall be installed in the system power and control cabinet to provide adequate illumination for nighttime maintenance operations. The light and receptacle shall each

be separately fused and useable although the entrance switch (3.8.4) is open. A 120 volt, single phase, 15 ampere, grounding-type receptacle with built in ground fault interrupter (GFI), shall be installed in the system power and control cabinet for maintenance purposes. The GFI shall be located adjacent to or in the receptacle. The GFI shall be a specification grade Underwriter's Laboratories listed device with pushbutton switches to permit manual test and reset operations.

3.8.9 Lightning Arresters.- The lightning arresters specified in 3.9.3.2 shall be installed in the system power and control cabinet for all power and control output circuits to the ODALS flashers. The arresters shall be wired to terminal blocks specified in 3.8.11 and shall be properly combined where necessary to meet circuit voltage requirements. In addition, a lightning surge protecter located inside the system power and control cabinet shall be connected to the control cabinet power input terminal block and meet the requirements of 3.5.3 for transient suppression. Lightning arresters are not required for the power output connections from the control cabinet to the remote control receiver/decoder unit (3.7.2).

3.8.10 Ground Lug.- A grounding lug shall be provided at the bottom inside of the cabinet. The lug shall have a slotted, hexagonal, green-colored head suitable for #6 bare copper ground wire.

3.8.11 Terminal Blocks.- All external connections shall terminate on terminal blocks of adequate size and voltage rating. The terminal blocks shall be the enclosed base type with pressure type terminal connectors, and shall meet the requirements of FAA-G-2100/1b, paragraph 1-3.16.11. Terminal blocks shall have ten percent unused terminals, but not less than two extra terminals, per terminal block unless otherwise specified. All terminals shall be marked as required in specification FAA-G-2100/1b, paragraph 1-3.12.4.5.

3.8.12 Cabinet Housing.- The cabinet shall be an outdoor, rainproof, dusttight, non-ventilated enclosure as specified herein. The cabinet shall be rigidly constructed and shall not distort or bend under normal methods of shipping, handling, installation or maintenance. It shall be stainless steel or aluminum. Stainless steel shall be in accordance with FAA-G-2100/1b, paragraph 1-3.15.1.1. Aluminum enclosures shall be anodized in accordance with MIL-A-8625. The cabinet shall be of sufficient size to accommodate the mounting panel and all necessary components and wiring and provide adequate clearance for field installation and maintenance. It shall have mounting means external to the cabinet cavity, and provision for locking. Space shall be provided in the cabinet for all external cable connections. Space shall be reserved for installation by others of a radio receiver/decoder unit and ancillary equipment (3.7.2). Terminal blocks (per 3.8.11) shall be located near the cable entrance to permit terminations of all external power and control wires feeding into the cabinet or from the radio receiver/decoder unit. Mounting lugs or bolts shall be provided on the bottom of the cabinet for mounting the cabinet vertically. Internal or external mounting bolts shall not protrude through the cabinet.

3.8.13 Cabinet Door.- The cabinet door shall open from the right side of the cabinet. The door hinge may be internally or externally mounted and shall be corrosion resistant. A doorstop shall be provided for locking the door in a 120 degree open position. Door gaskets shall be mounted on the cabinet housing. Gaskets shall be either continuous or strip gaskets. If strip gaskets are used; (a) the total number of strips used shall not exceed four, (b) the vertical and horizontal runs shall be continuous except where the vertical strips meet the horizontal strips, (c) the horizontal strips shall overlap the vertical strip and (d) the vertical strip shall be butted tightly against the horizontal strip. Gaskets shall be synthetic rubber or neoprene or a compositon gasket utilizing these two materials and shall be resistant to deterioration such as cracking, hardening or softening under the specified environmental conditions.

3.8.13.1 Instruction Book Holder.- An instruction book holder shall be attached to the upper half inside of the control cabinet door (3.8.13). The holder shall form a pocket for an 8 1/2 inch by 11 inch (22 X 28 cm) instruction book and shall be made of the same material as the cabinet door. Provision shall be made for attaching a removable wiring diagram plate (3.8.15) to the front of the holder.

3.8.14 Door Handle.- The door handle lever shall have provision for padlocking it closed in the vertical position. The holes for the padlock shall be aligned such that a 7/16 inch diameter rod can be passed horizontally through the holes when the door handle is in a locked position. The handle shall activate a two-point shoot bolt to firmly secure the door in the closed position. The door handle shall be within 2° of vertical when locked and shall keep the door completely closed regardless of what type or size of padlock is used.

3.8.15 Wiring Diagram Plate.- A wiring diagram plate shall be provided which matches the wiring diagram figure provided in the instruction book manuscript in accordance with FAA-D-2494/1a, paragraph 1-3.9.2.10. The plate shall be mounted on the instruction book holder. The plate shall be Type A, F, or H and the color style shall be Style I or IV in accordance with MIL-P-15024.

3.8.16 Component Mounting Panel.- A component mounting panel shall be attached to the back interior cabinet wall by stand-offs or spacers upon which all principal assemblies shall be mounted. The panel shall be of the same material as the cabinet. Means shall be provided on the panel for attaching all assemblies using single slotted screw fasteners. The threaded nut portion shall be permanently attached to the panel such that it will remain in position although the screw has been removed. A minimum of three complete threads in use is required when the screw is in place. Screws and threaded nuts shall be brass or stainless steel. Components shall be mounted via slotted mounting holes. All component assemblies shall have wire leads that terminate at screw terminals on terminal blocks or other assemblies such that a component assembly can be removed from the component panel without unsoldering wires. The mounting panel shall have adequate clearance to be easily removed through the cabinet door with all components installed. All components or assemblies shall be removable without the need for removing any other components or assemblies.

3.9 ODALS Light Units.- ODALS strobe light units shall be comprised of two separable assemblies, a power supply cabinet and an optical head. The strobe light shall be designed for installation and operation as one intergral unit, or where required, for remote installation of the optical head up to 44 feet (13.4 meters) from the power supply cabinet. The size of the strobe light unit, with optical head mounted on top of the power cabinet, shall not exceed 24 inches (0.6 meters) in width, by 24 inches (0.6 meters) in depth, by 34 inches (0.9 meters) in height. The unit weight shall not exceed 50 pounds (23 kilograms). All equipment shall be designed as required to meet the reliability and maintainability criteria (3.5).

3.9.1 Photometric Requirements.- The omnidirectional strobe light units shall provide, at nominal input voltage, the following light distribution throughout 360 degrees in azimuth and simultaneously throughout the area between 2 degrees and 10 degrees above the horizontal:

High Intensity-	5,000 $\pm$ 2,000 effective candelas
Medium Intensity-	1,500 $\pm$ 300 effective candelas
Low Intensity-	700 $\pm$ 200 effective candelas

Also, the average effective intensity shall be not more than 200 candelas between horizontal and 2 degrees above the horizontal during low intensity operation. The flash duration shall not be less than 0.5 nor more than 5 milliseconds at the high intensity level. The unit shall be designed to operate reliably on any circuit having a nominal rating of 240 volts with a temporary voltage variation not to exceed $\pm$ 10%. Primary voltage adjustment taps shall be incorporated on the power input transformer as specified in 3.9.3.4 to permit the flasher unit to meet the foregoing photometric requirements under varying supply voltage conditions. Skipping flashes or double flashing of the unit shall be cause for rejection. The photometric requirements of this specification shall be met even though the flash lamp used has the minimum published light output rating. The photometric requirements shall be met for cable runs ranging from 3 feet (0.9 meter) to 44 feet (13.4 meters) between the power supply cabinet and the remote optical head housing. The method of determining effective intensity shall be as required by Specification FAA-E-1100. The color shall be aviation white in accordance with MIL-C-25050.

3.9.2 Operating Requirements

3.9.2.1 Rating.- The ODALS strobe light units shall operate on a grounded 120/240 VAC $\pm$ 10% power input. The surge current at each flash shall not exceed nine amps (RMS) or 12.7 amps peak at 240 volts. The total system, consisting of seven each strobe light units, the system power and control unit, and all interconnecting cable required for the standard installation

plan, shall not consume more than 2.5 KW as measured with a residential type power meter, or a thermal meter giving a steady needle deflection, while operating continuously at the high intensity setting. The units shall be designed to operate reliably with a power input nominal rating of 210 - 250 VAC with temporary nominal voltage variation not to exceed ± 10% and control and trigger nominal input rating of 120 VAC ± 10%.

3.9.2.2 Triggering.- The strobe units shall flash in sequence as sepcified in paragraph 3.7. The trigger circuit of each unit shall be energized from the master timer specified in 3.8.6. The nominal voltage used for triggering shall be 120 volts AC ± 10%. The control cable between each strobe unit and the master timer will be a 1/C #19 AWG non-armored telephone cable (not furnished under this specification). The strobe units shall operate satisfactorily when located up to 3000 feet (900 meters) from the master timer. The design of the triggering circuits shall be such that failure of one strobe unit will not affect operation of the remaining strobe units. Components used for triggering shall be designed for a minimum life of 10 million flasher operations. The flash trigger relay shall plug into a standard octal socket.

3.9.2.3 Instensity Step Changing.- Each unit shall be designed for High, Medium, or Low intensity operation as described under paragraphs 3.7 and 3.9.1. Intensity control shall be accomplished by application of a 120V AC ± 10% signal(s) on two 1/C #19 AWG non-armored telephone cables from the system power and control unit (with the neutral power conductor completing the circuits). A single circuit from the system power and control unit shall be used to reduce the intensity of all seven strobe units from "High" to "Medium". Another single circuit from the system power and control unit shall be used to reduce the intensity of all seven strobe units from "Medium" to "Low". The strobe units shall have the capability of intensity step changing with the system operating. If necessary, in order to effectively switch flash capacitors, the control cabinet in 3.8 may automatically interrupt power to the falshers for a period not to exceed 1.5 seconds during intensity step changing. Circuitry shall be provided to prevent simultaneous step changing and triggering. In the event of loss of the Medium Intensity step control voltage, the strobes shall automatically revert to operation on the High Intensity setting. In the event of loss of the Low Intensity step control voltage, the strobes shall automatically revert to operation on the Medium Intensity setting. The design shall be such that no erratic arcing or relay operation occurs during any intensity step change. Components used for intensity step changing shall be designed for a minimum of 20,000 operations.

3.9.3 Power Supply Cabinet.- The ODALS strobe light power supply cabinet shall meet the requirements of paragraphs 3.8.12, 3.8.13, 3.8.14, and 3.8.16 for the system power and control unit, except as modified herein. The cabinet bottom shall be sufficiently rigid to permit field cutting holes and mounting the cabinet on three frangible couplings of the type shown in

FAA Drawing B-4904. The instruction book holder (3.8.13.1) and the wiring diagram plate (3.8.15) are not required. The cabinet shall be designed to permit mounting of the optical head directly on top of the cabinet. The contractor may, at his option, provide two adjustable tension case-type latches and a padlock hasp in lieu of the door handle (3.8.14) with shoot bolts. A safety interlock switch per paragraph 3.9.5 shall be provided.

3.9.3.1 Input Switch and Fuse.- Input power shall be controlled by a toggle switch. Circuit overload protection shall be accomplished by a suitably rated 3AG fuse mounted in a fuse extractor post. The switch and fuse shall be located in the upper right quadrant of the cabinet.

3.9.3.2 Lightning Arresters.- Lightning arresters shall be provided for all power and control input circuits, and installed as near as possible to their point of entrance to the housing. The arresters shall be Joslyn Model 2301-01, or approved equal and properly combined where necessary to meet the circuit voltage requirements.

3.9.3.3 Rectifiers.- The direct current voltages for the flash capacitors shall be obtained from a full wave rectifier using solid state diodes specified in 3.10.5.

3.9.3.4 Transformer.- The power transformer shall conform to MIL-T-27 type TF5RX02, size as required. Voltage taps in 20 volt increments from 200 - 260 volts shall be provided on the primary winding to accommodate any supply voltage within the 200 -260 VAC range. All primary taps shall be brought out to a single terminal block. The secondary winding shall be rated at 250 milliamps AC and such voltage as necessary to provide the DC voltage necessary but not exceed 2000 volts at 240 VAC input.

3.9.3.5 Component Mounting Panel.- The entire mounting panel (3.8.16) shall be removable from the cabinet with all components in place. The mounting panel shall have four slotted screw keyholes which will permit a single person to remove the mounting panel after lossening four retained screws, disconnecting the plug connector (3.9.3.7) and removing wires leading to the remote optical head and ground lug. Two metal handles with adequate clearance from components shall be attached to the left and right side of the mounting panel to facilitate removal and replacement of the mounting panel. The terminal blocks for external power and control terminations shall not be mounted on the component mounting panel, and shall be provided with cover plates to prevent electrical shock.

3.9.3.6 Optional Component Chassis.- The contractor may at his option, provide a horizontal component mounting chassis in lieu of the component mounting panel (3.9.3.5). All provisions applicable to the mounting panel shall be applicable to the chassis unless otherwise specified herein. The chassis shall be anodized aluminum or stainless steel of a gage sufficient

to support the weight of all components thereon without sagging or distortion, but in no case less than No. 14 B&S gage for aluminum or No. 16 U.S. Standard gage for stainless steel. Rails shall be provided on the interior sides of the cabinet housing, rigidly attached to properly position the chassis in the cabinet. Casters shall be mounted on the front of the chassis for engaging these rails to facilitate removal of the chassis. Front and rear stops shall be provided to further position the chassis within the housing and to prevent the chassis from inadvertently sliding out from the housing. When the chassis is in its normal operating position provision shall be made for locking it in place whether the cabinet door is opened or closed.

3.9.3.7 Plug Connector.- A plug connector consisting of a Type MS-3106A-18-20 plug with cable clamp and wire harness and a Type MS-3102A-18-20P box mounting receptacle as referenced in MIL-C-005015 shall provide all electrical connections between the incoming power and control terminal block and the mounting panel. The receptacle portion shall be mounted on the component mounting panel and shall be located to provide easy access from the front of the cabinet. The location of the receptacle on the panel shall be such as to keep the harness length as short as possible and to prevent snagging during removal of the mounting panel. The wire harness shall be enclosed in a heat shrinkable insulating plastic cover.

3.9.3.8 Closure Pieces.- Closure pieces shall be provided to securely seal all cabinet holes or openings created by the removal of the optical head for remote installation.

3.9.3.9 Grounding.- A ground lug per paragraph 3.8.10 shall be installed on the bottom of the cabinet. A copper grounding bus bar shall be installed on the removable component mounting panel, and a single No. 6 bare copper ground wire shall connect the bus bar and the ground lug.

3.9.4 Remote Optical Head.- The remote optical head shall be a single watertight assembly consisting of all items not mounted on or in the power supply cabinet. The optical head shall be designed for installation directly on the power supply unit or on a single vertical pipe having an outer diameter of 2.197 to 2.375 inches. All cables shall enter the optical head through the pipe mount opening. The optical head shall not exceed 200 square inches (0.13 square meters) in vertically projected area and shall not weigh more than ten pounds (4.5 kilograms). Means shall be provided to level the optical head within $\pm$ 1° in all directions when installed directly on the power supply unit or on a 2-inch diameter mounting piece of a low impact resistance tower per FAA-E-2604.

3.9.4.1 Optical Head Housing.- The optical head housing shall be comprised of two pieces, the optical dome and the base unit. The two pieces shall be durable, and designed for easy field disassembly and reassembly as required for maintenance access. A positive, water-tight gasketed seal and locking mechanism shall be provided. A safety interlock switch per paragraph 3.9.5 shall be provided.

3.9.4.2 Optical Dome.- The optical dome shall enclose the flash lamp and reflectors and shall be entirely free of bubbles, mold marks, or other imperfections which impair light transmission. The dome shall be made of glass or acrylic plastic, however, the material used shall not be subject to deterioration under the specified environmental conditions and shall be in accordance with Class A of MIL-C-7989. The color shall be aviation white per MIL-C-25050(ASG). Glass shall be 1/4 inch nominal thickness and shall be highly resistant to mechanical impact and abrasion. The gasket surface of the optical dome shall be either ground or molded to a sufficiently true surface to insure a tight joint. The dome shall be attached to the base unit (3.9.4.3) using a tight gasket made of material specified in 3.8.13 and mounted in such a manner that it can be easily removed or replaced.

3.9.4.3 Base Unit.- The base unit shall be constructed of stainless steel or aluminum as specified in 3.8.12 or of a non-ferrous material which is comparible in service life with that of a stainless steel or aluminum housing over the full range of environmental and operating parameters defined in this specification. It shall enclose a terminal block and all wiring and components necessary to operate the flash lamp. All components shall be securely mounted on a removable chassis or mounting bracket. The chassis or mounting bracket shall be held securely in position, however, mounting bolts shall not pass through the exterior housing surface. Access shall be provided for maintenance and replacement of all equipment components, without removal of other components.

3.9.4.4 Reflectors.- High quality aluminum reflectors with long-life reflective surfaces shall be used, either alone or in conjunction with fresnel lenses, to produce the light output and beam spread specified in 3.9.1. The reflector shall be provided with an alzac finish or with a clear anodized finish in accordance with MIL-A-8625, with a minimum finished thickness of 0.06 inches.

3.9.4.5 Socket.- The lampsocket shall be a plug-in type porcelain socket able to withstand the operating temperature of the flasher lamp. Insulating materials used in the socket shall be non-porous and non-absorbent of water. Screw terminals shall be provided on the socket for required wire terminations. The socket shall be attached to the lamp housing with two or more screws in a manner facilitating easy removal or replacement of the socket.

3.9.4.6 Flash Tube.- The flash tube shall be a plug-in type with a rated life of at least 500 hours when operated on the high intensity step. The effective intensity shall not decrease more than 30% during the minimum rated life and flash skipping (misfirings) shall be less than 1% with no skips or double flashes occuring consecutively.

3.9.4.7 Interconnecting Wire.- The ODALS design shall be such that all wire between the flasher power supply and the remote optical head shall fit through a 1/2 inch conduit. All such wire shall be single conductor and a maximum of five wires between the remote optical head and flasher power supply shall be used. Where wire having an insulation rating greater than 600 volts is required, the contractor shall provide enough such wire to permit continuous wire runs from the power supply to an optical head mounted on top of a 40 foot (12.3 meters) tower. All wiring shall enter the base unit via the 2" diameter mounting opening.

3.9.4.8 Terminal Block.- A terminal block, per paragraph 3.8.11, of adequate size and voltage rating shall be provided for terminating all incoming wires from the power supply unit.

3.9.4.9 Optical Shielding.- Materials and equipment shall be provided for the optical shielding of strobe light produced in any direction which is undesireable based on environmental or operational considerations. Shields shall be installed on the surface or inside of the optical dome.

3.9.5 Interlock Switches.- Interlock switches shall be incorporated in the optical head and power supply so that opening either of the units shall:

(a) Disconnect all incoming power and control circuits.

(b) Discharge all flash capacitors through a relay to a maximum value of 50 volts within 30 seconds. This requirement shall apply even if components which normally draw current from the high voltage circuits are removed.

The design shall also provide for permanently connected bleeder resistors to discharge the flasher capacitors to a maximum value of 50 volts within one minute in event of failure of the interlock switches. Means shall be provided to enable the interlock switches to be cheated by maintenance personnel with the flasher power supply cabinet door opened.

3.10 Electrical.- Electrical components shall meet the requirements specified herein unless otherwise specified in other sections of this specification. All components shall have the minimum life expectancy necessary for the system to achieve reliability requirements as specified in paragraph 3.5.2. All parts shall be designated and marked per paragraphs 1-3.11 and 1-3.12 of FAA-G-2100/1b.

3.10.1 Relays.- Relays shall be the hermetically sealed plug-in type and meet the requirements of FAA-G-2100/1b, paragraph 1-3.16.8 as modified herein. All covers used on the relays shall be opaque. The flash tube trigger relay shall have tungsten contacts and shall fit a standard octal socket.

3.10.2 Resistors.- Resistors shall meet the requirements of FAA-G-2100/1b, paragraph 1-3.16.9 excluding 1-3.16.9.1.

3.10.3 Capacitors.- Capacitors shall meet the requirements of FAA-G-2100/1b, paragraph 1-3.16.2 except that electrolytic capacitors shall not be used.

3.10.3.1 Flash Capacitors.- All flash capacitors shall be rated at 2500 volts DC minimum and shall be designed for the intended application. They shall have a life expectancy of one year of continuous duty at a normal working voltage of 2000 volts DC.

3.10.4 Inductors and Coils.- Inductors and coils shall meet the requirements of MIL-STD-454, Requirement 14.

3.10.5 Diodes.- Diodes shall meet the requirements of FAA-G-2100/3 for Category 1 devices. All diodes shall be clip-in units.

3.10.6 Transformers.- Transformers shall meet the requirements of MIL-T-27.

3.10.7 Fuses and Fuse Holders.- Fuses and fuse holders shall be in accordance with MIL-STD-454, Requirement No. 39, as modified by paragraphs 1-3.7.3.1 and 1-3.12.4.3 of FAA-G-2100/1b.

3.10.8 Terminal Blocks.- Terminal blocks shall meet the requirements of paragraph 3.8.11.

3.11 Wire and Cable.

3.11.1 Solid and Stranded Wire.- Stranded wire shall be used for wires and cables which normally are flexed in use and servicing of the equipment such as at terminal block terminations. In all other applications, either solid or stranded wire may be used, provided that stranded wire shall be used where so indicated by good engineering practice. All conductors shall be copper.

3.11.2 Current Rating of Wire.- All wire used in making circuit connections shall have a cross-section-area-to-current ratio of not less than 500 circular mils per ampere.

3.11.3 Color Coding.- All color coding of insulated wires shall be in accordance with the National Electrical Code and FAA-G-2100/1b, paragraph 1-3.10.6.2.1.

3.11.4 Cabling.- Wiring shall be grouped or cabled in accordance with FAA-G-2100/1b, paragraphs 1-3.10.7 and 1-3.10.7.2 and shall include provisions for strain relief.

3.11.5 Wire Connections and Terminations.- All wires terminating at screw terminals shall have crimp-on lugs with no more than one wire attached to each lug. No more than two lugs shall be attached to each screw terminal. Wire stake-ons and lugs shall have insulated terminals that crimp the conductor insulation as well as the conductor to provide additional mechanical support. All power wiring attached to terminal blocks shall have crimp-on wire pin terminals to reduce crushing and breaking of individual wire strands. All wiring leads from components or assemblies shall terminate at a terminal block, or terminal post, or stake of another component, or assembly such that any component or assembly can be removed without unsoldering wires. Wire splices between components, assemblies, or terminal blocks are prohibited. Soldering is permitted within components or assemblies, and shall be in accordance with MIL-STD-454, Requirement No. 5. Non-soldered wrapped wire connections in assemblies or components are prohibited.

3.12 Finishes

3.12.1 Painting.- The individual components of the ODALS system enumerated below shall be painted as follows: All surfaces (interior and exterior) of the system power and control cabinet (3.8.12) including the door and component mounting panel, the flasher power supply cabinet (3.9.3) including the door and equipment mounting panel, and the remote optical head base unit (3.9.4.3), shall be protected by not less than a primer coat, an intermediate coat, and a final coat of paint. The remote optical head base unit, if constructed of a non-ferrous material, does not require painting if the material color matches the aviation orange color requirements of 3.12.1.2. If painting of non-ferrous material is required to achieve the specified color, the type of paint and method of application with referenced applicable standards shall be approved by the Contracting Officer. The method of application shall produce a finish equal to or better than the finish achieved on metallic surfaces when performed in accordance with this specification.

3.12.1.1 Surface Preparation.- Surfaces to be painted or primed shall be prepared in accordance with MIL-T-704 for Type A surfaces. Surface preparation shall include masking, covering or otherwise protecting surfaces not to be painted or primed. This includes interface contact surfaces requiring electrical continuity for grounding purposes. Aluminum surfaces shall be anodized in accordance with MIL-A-8625 prior to priming.

3.12.1.2 Application.- All primer and paint coats shall be applied using a spray method in accordance with MIL-T-704. The prime coat shall conform to TT-P-645 or TT-E-485 for ferrous metal surfaces, TT-P-641 for galvanized metal surfaces and TT-P-1757 for aluminum surfaces. The color of the primer shall be different from the intermediate coat to provide a color contrast between coats. The intermediate and final coat for all surfaces shall conform to TT-E-489. The interior surfaces of the control cabinet and the flasher power supply cabinet shall be aviation white, Color No. 17875 or 27875, Feder Standard 595. All other surfaces, interior or exterior, shall be aviation orange, Color No. 12197, Federal Standard 595.

3.12.1.3 Finish.- The finish appearance of primer and paint coats shall be in accordance with MIL-T-704. The gloss of the intermediate and final coat shall be in accordance with TT-E-489 for the Federal color number of the paint color used. The final painted surfaces shall be free of blotches, scratches, runs, and holidays or unpainted areas.

3.13 Assembly and Marking.- All components shall be properly assembled and marked. Each electrical component or part thereof shall be identified by a reference disignation marked adjacent to the physical location of the part in the equipment and readily visible to maintenance personnel. Such identification shall be identical to reference designations used in instruction books for the equipment. All wiring shall, where possible, be grouped, color coded, laced into cables, neatly clamped and properly marked. Marking shall be in accordance with FAA-G-2100/1b, paragraph 1-3.12.

3.14 Nameplate.- Each equipment component which has an FAA equipment type number designation shall be furnished with a nameplate, in accordance with Drawing B-21216, and FAA-G-2100/1b, paragraph 1-3.13 through 1-3.13.3. The nameplate shall be fastened to the equipment exterior surface with a thermoplastic or thermosetting adhesive conforming to MIL-STD-454D, Requirement 23 and suitable for use under the environmental and operational conditions specified for the equipment.

3.15 Instruction Book Manuscripts.- A camera ready instruction book manuscript shall be furnished in accordance with FAA-D-2494/1a and FAA-D-2494/2a.

3.15.1 Instruction Books.- The Government will reproduce and prepare instruction books from the approved camera ready copy (3.15) and furnish copies to the contractor for shipment with the equipment. Two instruction books shall be included with each set of equipment comprising a system and shall be packaged with the control cabinet (3.8).

4. QUALITY ASSURANCE PROVISIONS

4.1 Quality Control Provisions.- The contractor shall provide and maintain a quality control program in accordance with FAA-STD-013. All tests and inspection made by the contractor shall be subjected to Government inspection. The term "Government inspection," as used in this specification, means that an FAA representative will witness the contractor's testing and inspection, and will carry out such visual and other inspection as deemed necessary to assure compliance with contract requirements.

4.2 Maintenance and Reliability Provisions.- The contractor shall submit four copies of a maintainability program plan per 3.5.1.4 and a reliability program plan per 3.5.2.4 to the Contracting Officer within 45 days of the contract award date. The Government will require 14 days to review and evaluate. One copy will be returned to the contractor, either with a statement of approval of the plans or a statement pointing out deficiencies requiring correction.

4.2.1 Maintenance and Reliability Status Reports.- Status reports (4 copies) on both maintenance and reliability programs shall be submitted by the contractor to the Contracting Officer or his representative every 60 days. These status reports shall meet the requirements of MIL-STD-470, paragraph 5.12 and MIL-STD-785A, paragraph 5.6, and may be combined under a single status report document with separate headings.

4.2.2 Maintainability and Reliability Demonstration Test Plan.- Four copies of detailed proposed test procedures to be used for maintainability and reliability demonstration testing (4.4.4 and 4.4.5) shall be submitted to the Contracting Officer at least 30 days in advance of the scheduled test start dates. The test plans do not have to be provided in extensive detail in the maintainability and reliability program plans (3.5.1.4 and 3.5.2.4).

4.3 Notification of Readiness for Inspection.- After receipt of approval of test procedures (4.1 and 4.2.2) and test data forms (FAA-STD-013), the contractor shall notify the Government Contracting Officer in writing that he is ready for government inspection. Such notification shall be given in time to reach the Contracting Officer not less than five work days before the contractor desires inspection to start.

4.3.1 Invoice Submission.- Prior to the first inspection, the contractor shall submit to the FAA representative copies of invoices covering shipment of each item from the supplier's plant to that of the prime contractor. Each invoice shall carry the vendor's certification that each item furnished meets the requirements of this specification. The certification shall be traceable to the part or material manufacturer's quantitative test data pertaining to the specific part or material. Vendor certification does not constitute FAA acceptance of any part or unit of equipment provided under this specification nor release that part or unit from acceptance testing by the contractor.

4.4 Test Methods.- Testing of the equipment shall be performed as follows.

4.4.1 Design Qualification Test.- The first unit of production of each component is designated as the production model. Where the complement of a system and the prescribed manner of testing requires the initial production of a group of identical units, e.g., seven ODALS flasher assemblies, then all members of that group will be referred to hereinafter as part of the production model. The production model shall be subjected to the tests specified in 4.4.4, 4.4.5, and 4.5 through 4.5.13.1. The production model and revalidation production units after passing the design qualification tests, shall be deliverable items under the contract after replacing all flashtubes with new accepted flashtubes in accordance with 4.5.13.1.

4.4.2 Production Unit Test.- Testing of the production units shall start after acceptance of the production model. Tests on production units shall be as specified in 4.5.10 through 4.5.13.2 excluding 4.5.13.1.

4.4.3 Revalidation Test.- Tests speceified in 4.5.3 and 4.5.6 through 4.5.13.1 performed on the production model shall be repeated on like components selected by the FAA representative from any production units produced after 50% of the total units ordered have been manufactured and accepted. In event of a unit failure, the contractor shall take corrective action as directed by the Contracting Officer to resolve the problem. If analysis of the failure indicated potential defects in previously shipped equipment, the contractor shall correct these deficiencies at his expense in a manner directed by the Contracting Officer. No further equipment will be accepted until such deficiencies are resolved.

4.4.4 Maintainability Demonstration Tests.- Maintainability demonstration tests shall be performed per FAA-G-2100/1b, Amendment 2, paragraph 1-4.3.6 on the production model. The tests shall be conducted in accordance with MIL-STD-471 to verify all quantitative maintenance values required by the specification.

4.4.5 Reliability Demonstration Tests.- Reliability demonstration tests shall be performed per FAA-G-2100/1b, Amendment 2, paragraph 1-4.3.6 on the production model. Reliability demonstration tests may be performed concurrently with the 150 hour operational test (4.5.13.1) unless the reliability tests would require interruption of the 150 hour test. Reliability demonstration tests shall be in accordance with MIL-STD-781, Plan XXV. In addition to the production model, any additional ODALS equipment required for testing per MIL-STD-781 shall be provided by the contractor. Flashtubes in these systems shall be replaced prior to equipment delivery.

4.5 Test Procedures.- The environmental tests specified in 4.5.1 through 4.5.6 shall be conducted on one system power and control unit (3.8) and one ODALS Light unit (3.9). Operational tests required during or after environmental tests as specified in the particular test methods shall consist of at least one operational cycle specified in 4.5.13.1(a) through (f) with all test components connected together. Dummy wiring loads shall be imposed on the equipment as required to simulate system loads. All test results including derating data shall be forwarded to the Contracting Officer upon completion of the tests.

4.5.1 Humidity.- The test shall be in accordance with Procedure I, Method 507.1 of MIL-STD-810C except that a total of three complete cycles (72 hours) will be required and the maximum temperature shall be plus 55°C (131°F).

4.5.2 Altitude.- The test shall be in accordance with Procedure I, Method 504.1 of MIL-STD-810C. The equipment shall be tested at atmospheric pressures corresponding to sea level and 6,600 feet (2,000 meters) altitude at both minus 55°C (-67°F) and plus 55°C (+131°F).

4.5.3 Temperature.- The high temperature test shall be in accordance with Procedure II, Method 501.1 of MIL-STD-810C except the temperature shall be plus 55°C. The low temperature test shall be in accordance with Procedure I, Method 502.1 of MIL-STD-810C except the temperature shall be minus 55°C, two hour operational test to start two hours after temperature stabilization. Procedure I shall be performed three times.

4.5.4 Sand and Dust.- The test shall be in accordance with Procedure I, Method 510.1 of MIL-STD-810C, delete steps 2 and 3, rotate equipment 120° twice. Air velocity shall be 2500 ± 500 feet (760 ± 150 meters) per minute.

4.5.5 Salt Spray.- The test shall be in accordance with Procedure I, Method 509.1 of MIL-STD-810C, not less than 168 hours. Salt build-up as a result of test may be removed with tap water.

4.5.6 Rain.- The test shall be in accordance with Procedure I, Method 506.1 of MIL-STD-810C.

4.5.7 ODALS Light Unit Electrical Tests.- An ODALS system shall be assembled and operated to verify power consumption requirements of paragraph 3.9.2.1 are met. One ODALS light unit assembly shall be operated over the full range of power supply, control, and trigger voltages specified in 3.9.2.1, 3.9.2.2 and 3.9.2.3.

4.5.8 Transient Suppression Test.- The system power and control cabinet and one ODALS light power supply shall be tested for transient suppression conformance with the requirements specified in 3.5.3. The test method shall be developed using ANSI C37.90a as a guide and shall be approved by the Contracting Officer. The transient suppression test requirements for the revalidation test (4.4.3) may be waived by the Contracting Officer based on all previous test results and/or actual experiences gained from site installations.

4.5.9 Capacitor Discharge Circuit Test.- The flash capacitor discharge circuit provided through the interlock switches shall be tested for conformance with the requirements of paragraph 3.9.5. The permanently connected bleeder circuit shall also be tested.

4.5.10 Visual Inspection.- All components shall be visually inspected to determine compliance with the specification requirements.

4.5.11 Photometric Test.- Tests shall be performed on all ODALS light units in accordance with FAA-E-1100 to prove conformance with paragraph 3.9.1. These tests shall include verification of the following:

(a) Effective intensity at 2-degrees above horizontal at Low, Medium and High intensity step positions.

(b) Effective intensity at 6-degrees above horizontal at Low, Medium and High intensity step positions.

(c) Effective intensity at 10-degrees above horizontal at Low, Medium and High intensity step positions.

In addition one flasher assembly each selected from the production model and the revalidation model shall have isocandela plots of their beam intensity provided. The plot shall include the area below 2-degrees to the horizontal to demonstrate the average intensity in this area is less than 200 candelas.

4.5.12 Dielectric Test.- A dielectric test shall be made on all equipment components after complete assembly. For power wiring the test voltage shall be twice circuit voltage plus 1000 volts, 60 Hz, applied for one minute between insulated parts and ground. Control wiring shall be checked in the same manner using 1000 volts. Components not designed for this test such as capacitors, diodes, etc., may be disconnected for the test.

4.5.13 Operational Tests.- The power and control cabinet and seven omnidirectional light units which comprise each ODALS system shall be connected and operated as described below. The convenience outlet (3.8.8) shall undergo three tests using an externally faulted source to verify proper operation of the ground fault interrupter and reset operations. Operation of the remote optical head and power supply cabinet shall be attempted with the interlock switches in the open position to verify proper operation of the interlocks. All operating requirements of the equipment shall be checked over the full range of voltage input variations (3.8.1) at the control cabinet power input terminal. The step operation of the components shall be verified through the remote control interface circuits (3.7.2) of the control cabinet.

4.5.13.1 One Hundred Fifty (150) Hour Test.- A 150 hour continuous operation test shall be performed on the production model and on the production system used for revalidation. All intensities shall be checked using the remote control inputs to cycle the system as follows:

(a) Low intensity - 5 minutes, $\pm$ 1 minute.
(b) Off - 2 seconds, maximum.
(c) Medium intensity - 5 minutes, $\pm$ 1 minute.
(d) Off - 2 seconds, maximum.
(e) High intensity - 5 minutes, $\pm$ 1 minute.
(f) Off - 60 seconds, $\pm$ 10 seconds.
(g) Repeat cycle, starting with (a).

The local control switch shall be manually cycled through the OFF, LOW, MEDIUM and HIGH intensity step positions a minimum of twenty times at the completion of the 150 hour test. Flashtubes used in the 150 hour test shall not be a part of the FAA procurement and shall be replaced with new flashtubes prior to system delivery.

4.5.13.2 Two (2) Hour Test.- All production systems not tested under 4.5.13.1 shall have a 2 hour continuous operation test performed on them using the remote control inputs as follows:

(a) High intensity -1 hour, ± 2 minutes.
(b) Cycle 4.4.15.1 (a) through (g) - 1 hour ± 2 minutes.

The local control switch shall be manually cycled through the OFF, LOW, MEDIUM and HIGH intensity positions a minimum of twenty times at the completion of the 2 hour test.

5. PREPARATION FOR DELIVERY

5.1 General.- The equipment shall be prepared for delivery in accordance with MIL-E-17555, preservation and packaging level "A", and packing level "C". Marking of equipment is to be in accordance with MIL-STD-129.

6. NOTES

6.1 None.

* * * *

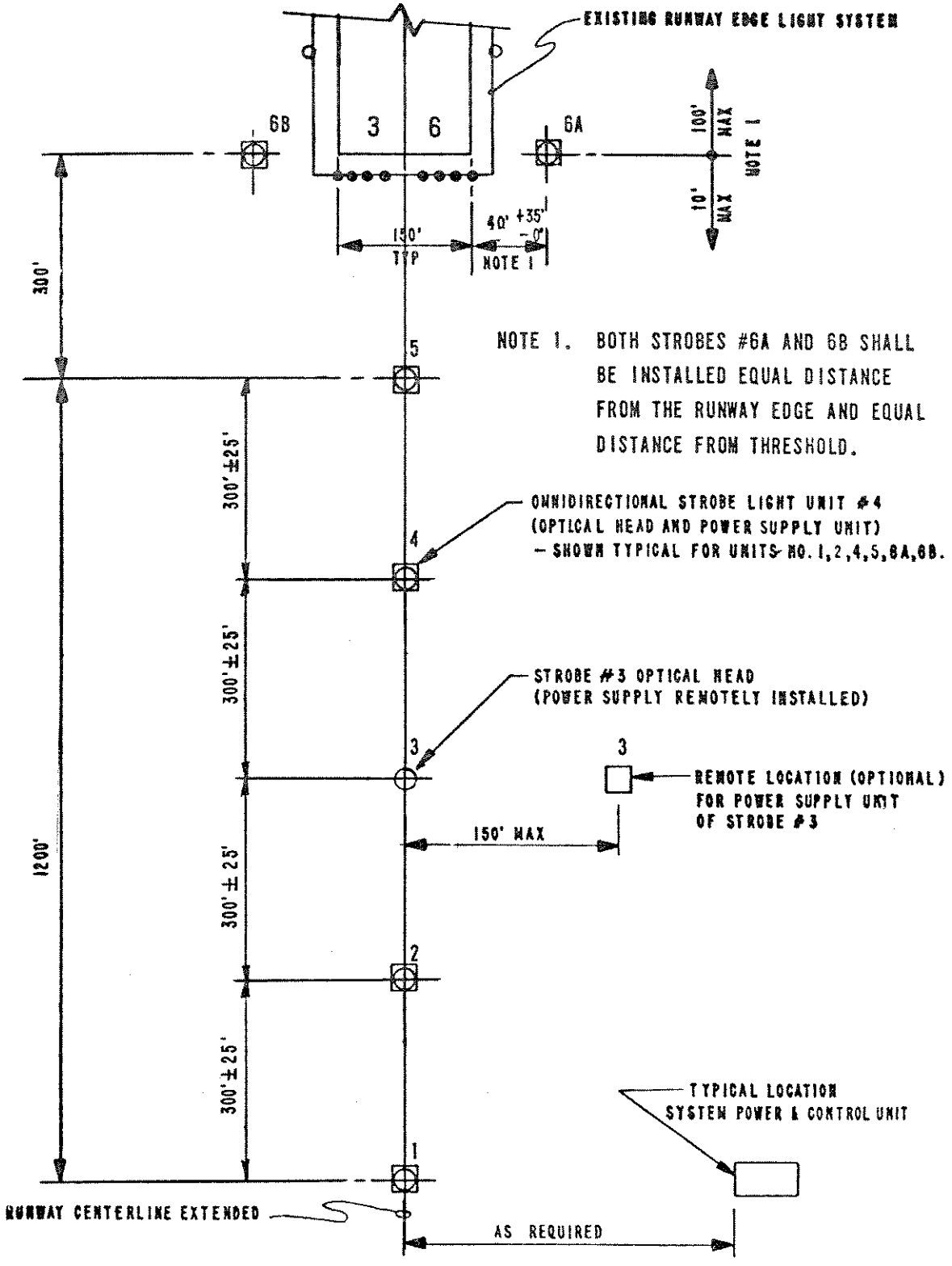
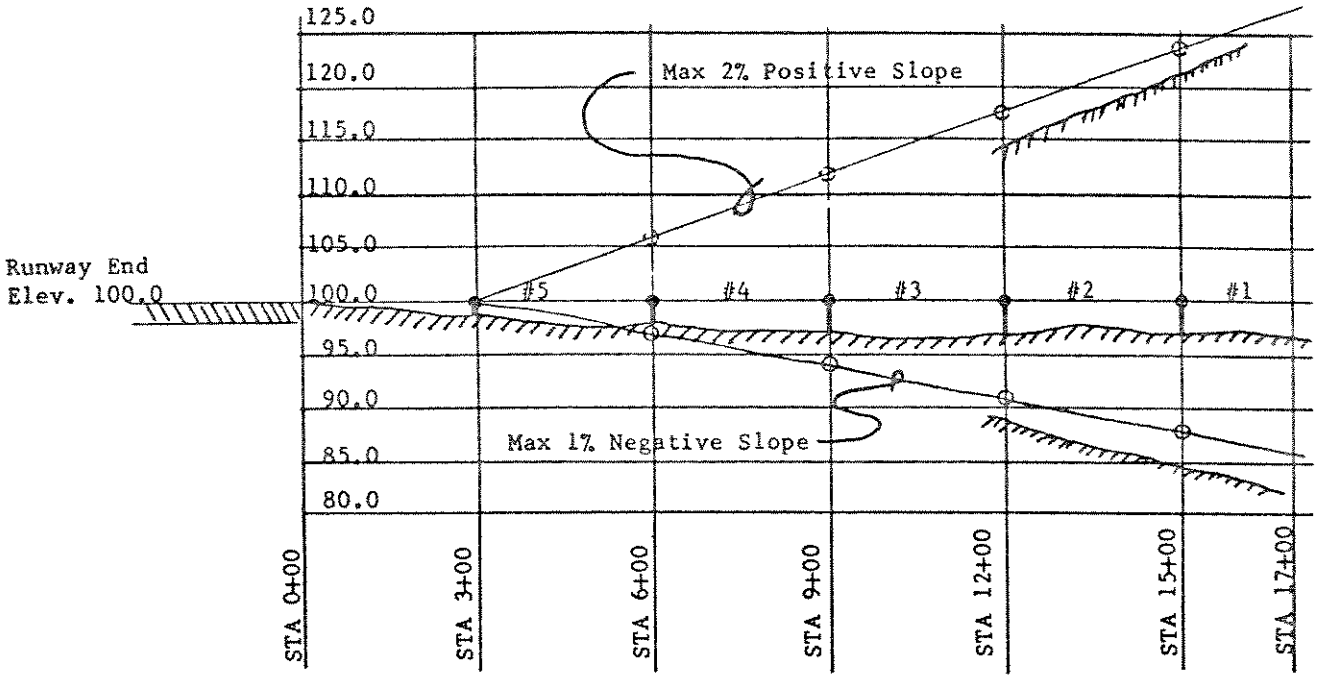


FIGURE 1 SYSTEM LAYOUT OMNIDIRECTIONAL APPROACH LIGHTING SYSTEM

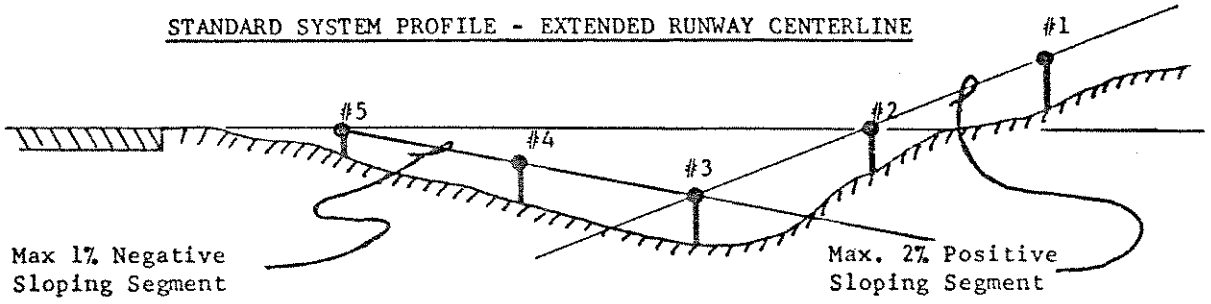
NOT TO SCALE



NOTES:

1. Units #6A and #6B are not shown
2. Unit #5 shall be at runway end elevation ± 24" Max.

STANDARD SYSTEM PROFILE - EXTENDED RUNWAY CENTERLINE



NOTES:

1. Max slope gradients are 2% positive and 1% negative.
2. Max of two sloping segments per system.
3. Each segment must contain three lights.
4. Negative - Positive combination of sloping segments is illustrated. Any combination of horizontal, negative, and positive segments is permissible.

ALLOWABLE SLOPING SEGMENTS

FIGURE 2 - ODALS LIGHTING SYSTEM PROFILES

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